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Comparison of astigmatism in three-year-old children with epiblepharon who underwent closer examination in a vision screening program

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ABSTRACT

This study aimed to compare 3-year-old children with suspected astigmatism and refractive errors in a vision screening program (VSP) and those diagnosed with epiblepharon on closer examination (CE). In a population of 1,250 children in a VSP conducted between April 2014 and March 2021, 168 children received a CE rating, and 89 patients subsequently underwent CE. The handheld refractors used in VSP were SureSight® and Spot®VisionScreener (Welch Allyn). In CE, a 5 m Landolt C ring angular vision test and auto-ref/keratometer TONOREF™ II (NIDEK) was used for measurement in non-cycloplegia. Epiblepharon was diagnosed by an ophthalmologist using slit-lamp microscopy. The patients were divided into epiblepharon and non-epiblepharon groups for CE. VSP detected a cylindrical power of 1.65 ± 2.25 D and 0.86 ± 0.74 D, respectively, in the epiblepharon and without epiblepharon groups. CE detected an uncorrected visual acuity of 0.42 ± 0.46 and 0.16 ± 0.29 (logMAR), a corrected visual acuity of 0.22 ± 0.31 and 0.09 ± 0.24, a subjective cylindrical power of 0.65 ± 1.15 D and 0.23 ± 0.56 D, and corneal astigmatism of 1.97 ± 0.93 D and 1.45 ± 0.82 D in the epiblepharon and without epiblepharon groups, respectively; significant differences were observed for all parameters ($p < 0.05$). Among 3-year-old children with suspected amblyopia or refractive error not reaching the reference level, those with epiblepharon had more astigmatism than those without it. If a case of high astigmatism is found in the refractive test, an epiblepharon may be present.

Key words: *Vision screening program*, *Epiblepharon*, *Astigmatism*

INTRODUCTION

Epiblepharon is a congenital eyelid anomaly that is frequently observed during childhood, with an incidence of 26.2%[11]. It is more common in Asian races[7] and its frequency decreases with age[6]; however, the risk increases with obesity[10]. Hayasaka et al. showed a slight male predominance in 6–8-year-old children and a slight female predominance in older children[1]. Severe epiblepharon can cause keratitis and other symptoms[2]; hence, treatment is recommended at an early age.

In Japan, based on the Maternal and Child Health Act, a vision screening program (VSP) was conducted for 3-year-old children[5]. Visual acuity testing and non-cycloplegic refraction were performed; however, the confirmation of epiblepharon was not included in the evaluation. Epiblepharon was discovered only during a closer examination (CE) following VSP. If CE is not requested following VSP, epiblepharon detection is delayed.

The relationship between epiblepharon and astigmatism has been reported previously[8]. As refractive errors such as astigmatism pose a risk of amblyopia, early detection and treatment are warranted. Therefore, clarifying the extent to which children with suspected refractive errors on VSP have epiblepharon would be useful for future health screening activities. In this study, we compared the refractive values of children with suspected refractive errors on VSP and those diagnosed with epiblepharon on CE to those without epiblepharon.

MATERIALS AND METHODS

After the children were evaluated by the VSP, their parents were informed via a document on a website that their children's VSP data may be used in research conducted at hospitals. Those who did not wish for the data to be used in this study submitted a non-participation statement in the research consent form, and their data were excluded. This study was approved by the ethics review board of Kamiamakusa General Hospital (#2021-010). The committee approved the opt-out consent form for participants, in lieu of written informed consent. This retrospective study was conducted in accordance with the Declaration of Helsinki.

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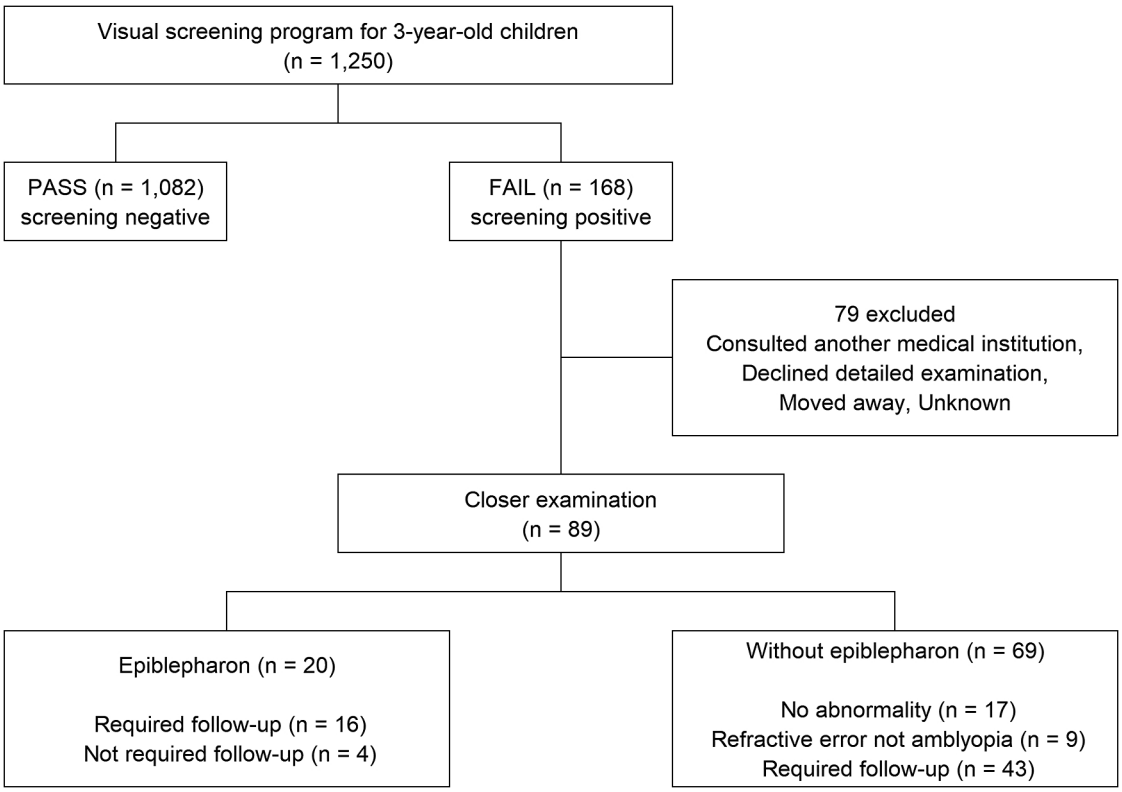

Figure 1 Results of screening and closer examination. Among the 1,250 3-year-old children, 168 are in the FAIL group. Among them, 89 are followed-up, 20 have epiblepharon, and 69 are without epiblepharon.

The study population comprised 1,250 participants who underwent VSP in Kamiamakusa City between April 2014 and March 2021. Of these, 168 received a CE rating. Eighty-nine patients who subsequently underwent CE at Kamiamakusa General Hospital were included in this study. The VSP was conducted by four certified orthoptists with at least 3 years of experience from the CE medical institution.

In the VSP, a 2.5 m Landolt C ring angular vision test and a handheld refractor were used for measurement in non-cycloplegia. The handheld refractors used were SureSight® (2014–17) and Spot® VisionScreener (2018–21) (Welch Allyn Inc., Skaneateles Falls, NY, USA). The decimal visual acuity for passing VSP was set at 0.50. The cutoff values for refraction were set at ± 2.00 D for spherical power and −1.25 D for cylindrical power; the spherical equivalent was not used[3]. Children who met the referral criteria for any one test were considered "FAIL," whereas only children who passed all two tests were considered "PASS."

Physical parameters, such as height, weight, and body mass index, were not obtained in this study. For CE, the 5 m Landolt C ring angular vision test and auto-ref/keratometer TONOREF™ II (NIDEK CO., LTD, Gamagori, Japan) were used. Epiblepharon was diagnosed by an ophthalmologist using a slit-lamp microscope.

Visual acuity was converted to the logarithm of the minimum angle of resolution (logMAR) scale for analysis. Astigmatism was converted into absolute values and analyzed. The results were analyzed using SPSS (version 26.0; IBM Corp., Armonk, NY, USA). The patients were divided into PASS and FAIL groups for VSP and epiblepharon and without epiblepharon groups for CE. Mann–Whitney U and Fisher's exact tests were used for continuous and categorical variables, respectively. Continuous variables are presented as the mean ± standard deviation. The statistical significance level was set at $p < 0.05$ (two-tailed test).

RESULTS

Results of the VSP

The mean age of the 1,250 patients who underwent the VSP was 37.4 ± 1.8 months; 642 boys and 608 girls were included. Of these, 1,082 (86.6%) had no suspected abnormality (PASS) and 168 (13.4%) required CE (FAIL) (Figure 1). The mean ages in the PASS and FAIL groups were 37.4 ± 1.6 and 37.7 ± 2.4 months, respectively, with no significant difference ($p = 0.80$). There was also no significant difference between the sexes in the PASS (551 boys and 531 girls) and FAIL (91 boys and 77 girls) groups ($p = 0.46$). The respective visual acuity was 0.30 ± 0.00 logMAR for PASS and 0.40 ± 0.21 logMAR for FAIL. The refractive values were significantly different between the PASS and FAIL groups, with a spherical power of 0.98 ± 0.52 D and 2.16 ± 1.50 D and cylindrical power of 0.33 ± 0.39 D and 0.93 ± 1.17 D (both $p < 0.05$). Of the 168 patients in the FAIL group, 89 (53.0%) were able to visit our clinic, and their progress could be monitored (Table 1).

Results of the CE

The age of the 89 children who underwent CE was 37.9 ± 2.3 months; 37 boys (41.6%) and 52 girls (58.4%)

Table 1 Comparison of vision screening programs by determination.

	PASS (n = 1,082: 86.6%)	FAIL (n = 168: 13.4%)	*p*-value
Age (months)	37.4 ± 1.6	37.7 ± 2.4	0.80*
Sex, n (%)			0.46†
Boys	551	91	
Girls	531	77	
Visual acuity (logMAR)	0.30 ± 0.00	0.40 ± 0.21	< 0.05*
Spherical power (D)	0.98 ± 0.52	2.16 ± 1.50	< 0.05*
Cylindrical power (D)	0.33 ± 0.39	0.93 ± 1.17	< 0.05*

logMAR: Logarithm minimum angle of resolution
D: Diopter
* Mann–Whitney U test
† Fisher's exact test

were included. CE diagnoses included no abnormality (false-positive) in 17 cases (19.1%), refractive error not amblyopia in nine cases (10.1%), follow-up including amblyopia in 43 cases (48.3%), and epiblepharon in 20 cases (22.5%). Among the 20 patients with epiblepharon, 16 (18.0%) had refractive errors that required follow-up.

Epiblepharon findings

A total of 34 and 144 eyes were included in the epiblepharon and without epiblepharon groups, respectively. There were 14 cases of epiblepharon in both eyes, and six cases had unilateral abnormality (four in the right eye and two in the left eye). The uncorrected visual acuity detected by the VSP in the epiblepharon and without epiblepharon groups was significantly different at 0.51 ± 0.29 logMAR and 0.36 ± 0.16 logMAR, respectively ($p < 0.05$). The uncorrected visual acuity detected during CE was 0.42 ± 0.46 logMAR and 0.16 ± 0.29 logMAR, respectively, and the corrected visual acuity was 0.22 ± 0.31 logMAR and 0.09 ± 0.24 logMAR, respectively, in the epiblepharon and without epiblepharon groups (both $p < 0.05$). The objective refractive power on VSP was 2.66 ± 1.95 D and 1.75 ± 1.36 D for spherical power and 1.65 ± 2.25 D and 0.86 ± 0.74 D for cylindrical power respectively, both of which were significantly different ($p < 0.05$). The objective refractive power on CE was 1.99 ± 2.70 D and 1.26 ± 1.84 D for spherical power ($p = 0.14$) and 1.42 ± 1.03 D and 0.96 ± 0.75 D for cylindrical power, respectively, with a significant difference only for cylindrical power ($p < 0.05$). The subjective refractive power on CE was 1.44 ± 2.68 D and 0.71 ± 1.67 D for spherical power ($p = 0.07$) and 0.65 ± 1.15 D and 0.23 ± 0.56 D for cylindrical power, respectively, with a significant difference only for cylindrical power ($p < 0.05$) (Table 2).

Corneal astigmatism was significantly different at 1.97 ± 0.93 D and 1.45 ± 0.82 D ($p < 0.05$) (Figure 2).

DISCUSSION

This was a community-based case-control study of 3-year-old children in Japan. The age of 3 years has important implications for the developmental process of the visual system. This is the critical period when the development of the vision system peaks and a subjective response becomes possible, thereby enabling vision screening. Nearly all 3-year-olds in Japan undergo VSP, making subsequent care relatively easy. Therefore, the study population was limited to 3-year-old children.

The proportion of children in the FAIL group, as screened with the VSP, was 13.4%, with no difference in age in months, or sex. The refractive power in FAIL was approximately twice as high as that in PASS for spherical power, and approximately three times higher for cylindrical power. Recently, the importance of measuring the refraction at VSPs has become apparent[3]. This is because refraction measurement, in addition to the visual acuity test, increases the detection rate of abnormalities. However, even in Japan, the responses vary across municipalities owing to differences in the initial cost and inspection skills of the examiner. Considering the economic loss attributed to amblyopia, the initial cost of refractive measurement instruments is not a significant burden. All companies promote handheld refractors, making measurement convenient in children, and with a price reduction, refractive examination at VSPs is expected to become more widespread.

The prevalence of epiblepharon in the study population was 22.5%; however, this is not comparable to the general prevalence because it was limited to 3-year-old children with (or suspected of having) visual acuity or refractive error. The binocular-to-monocular ratio was 7:3. In this study, the uncorrected visual acuity at VSP and uncorrected and corrected visual acuity at CE were significantly lower in the presence of epiblepharon. Refractive error was the main cause of decreased visual acuity. This was because the spherical and cylindrical powers were significantly higher in the VSP and cylindrical power (subjective and objective values) in the CE. Additionally, the presence of epiblepharon was associated with significantly higher corneal astigmatism, suggesting that epiblepharon induced astigmatism by altering corneal shape. Assessments for epiblepharon (photophobia, frequent blinking, and rubbing of the eyelid) should be included in VSP to prevent the development of amblyopia. In contrast, the need for surgery should also be considered in cases of severe epiblepharon.

Table 2 Comparison of the visual parameters of the vision screening program and closer examination of epiblepharon

	Epiblepharon (n = 34)	Without epiblepharon (n = 144)	*p*-value
Affected eyelid, n (%)			
Bilateral	14 (70.0)	—	
Right	4 (20.0)	—	
Left	2 (10.0)	—	
Uncorrected visual acuity (logMAR)			
VSP	0.51 ± 0.29	0.36 ± 0.16	< 0.05*
CE	0.42 ± 0.46	0.16 ± 0.29	< 0.05*
Corrected visual acuity (logMAR)			
VSP	—	—	
CE	0.22 ± 0.31	0.09 ± 0.24	< 0.05*
Objective refractive power for VSP (D)			
Spherical power	2.66 ± 1.95	1.75 ± 1.36	< 0.05*
Cylindrical power	1.65 ± 2.25	0.86 ± 0.74	< 0.05*
Objective refractive power for CE (D)			
Spherical power	1.99 ± 2.70	1.26 ± 1.84	0.14*
Cylindrical power	1.42 ± 1.03	0.96 ± 0.75	< 0.05*
Subjective refractive power for CE (D)			
Spherical power	1.44 ± 2.68	0.71 ± 1.67	0.07*
Cylindrical power	0.65 ± 1.15	0.23 ± 0.56	< 0.05*

logMAR: Logarithm minimum angle of resolution
VSP: Vision screening program
CE: Closer examination D: Diopter
* Based on Mann–Whitney U test

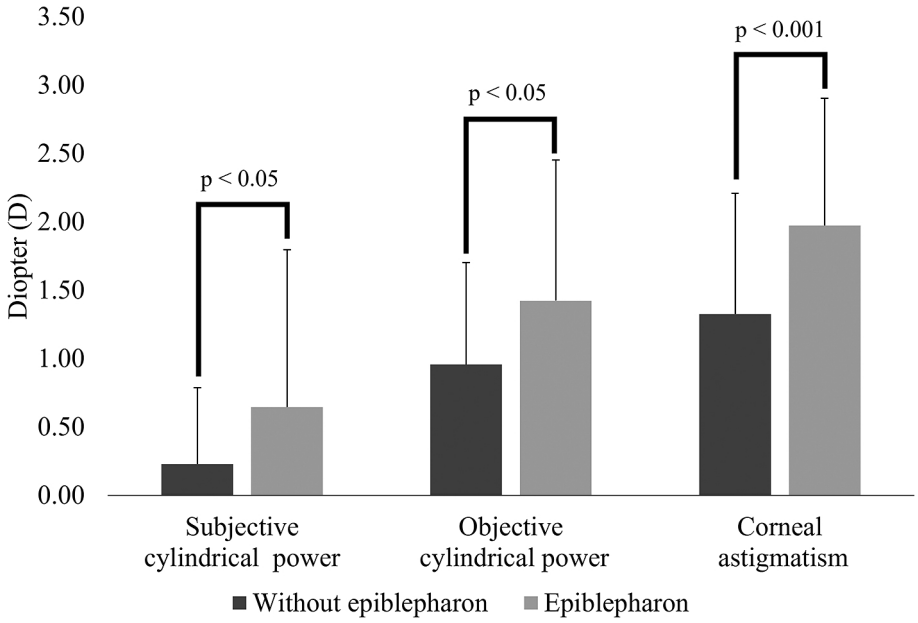

Figure 2 Comparison of astigmatism. Corneal astigmatism is significantly higher in children with epiblepharon than in those without epiblepharon.

A limitation of this study was that its single-center nature restricted the demographic variability among the recruited patients. Asian children are more prone to epiblepharon. In most Asians, the epicanthal folds remain a distinctive feature throughout the growth period, even until adulthood. These folds occur because of an underdeveloped nasal root and excess horizontal medial canthal skin relative to vertical skin deficiency[4].

Eighty percent of facial development in children is completed by the age of seven[9]. Epiblepharon reportedly resolves spontaneously with age[8]. However, this implies a loss of the critical period in visual development, which may have led to an underestimation of epiblepharon prevalence. Therefore, it is desirable to observe whether epiblepharon is associated with high refractive power in VSP. Additionally, the extent of epiblepharon was not assessed using CE. Further research is warranted to clarify the correlation between the extent to which the

eyelid compresses the cornea and an increase in refractive power. Since 3-year-old children with epiblepharon have higher astigmatism, careful screening by VSP and attention to changes in visual acuity during follow-up are important. However, evaluation of the cylindrical power alone is not sufficient to prevent the risk of epiblepharon; therefore, it is important to check not only the refractive values but also to interview parents for behaviors such as squinting and rubbing.

Among 3-year-old children with suspected amblyopia or refractive error not reaching the reference level, those with epiblepharon had more astigmatism than those without it. If a case of high astigmatism is found in the refractive test, it should be noted that an epiblepharon may be present.

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